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Constructive-critical realism as a philosophy of science and religion

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Although highly disputed, critical realism (in Ian G. Barbour's style) is widely known as a tool to relate science and religion. Sympathising with an even more stringent hermeneutical approach, Andreas Losch had argued for a modification of critical realism into the so-called constructive-critical realism to give humanities with its constructive role of the subject due weight in any discussion on how to bridge the apparent gulf between the disciplines. So far, his constructive-critical realism has mainly been developed theologically. This paper will evaluate whether constructive-critical realism is suitable as a philosophy of both science and religion and an appropriate basis for the science and religion discourse. In his original account of the critical realist philosophy of science, Barbour discussed and modified agreement with data, coherence, scope and fertility as criteria for good science, and for religion as well. The article discusses each of the criteria in how far Barbour does justice to the relevant concept, both in science and religion, and it will ask how to eventually modify the criteria for a maybe more sustainable bridge between science and religion, drawing on the idea of constructive-critical realism. Niels Henrik Gregersen's contextual coherence theory will play a significant role in this regard. The conclusion suggests a deeper meaning of the fertility criterium, embracing ethical fruitfulness as well. As constructive-critical realism fully acknowledges the importance of the role of the knower in the process of knowing, it leads us from pure epistemology into ethics.

Contribution: (1) The science and religion debate, inspired by critical realism, is identified as mainly theological discourse about the influence of science on religion; (2) the analysis of truth criteria in Losch's constructive-critical version of realism proposes an emphasis on correspondence in science and coherence in the humanities; and (3) the deeper meaning of the criterium of fertility in this philosophical stance is highlighted, including ethical fruitfulness.

Keywords: critical realism; constructive-critical realism; criteria; contextual coherence; science; religion; epistemology; ethics; Anthropocene.

Introduction

Critical realism has long been, and somehow still is, the most prominent epistemological stance in the science and religion discourse, at least in the Anglo-American sphere (Losch 2009; Van Kooten Niekerk 1998). Developed and promoted by three scientist-theologians (first Ian G. Barbour, then followed by Arthur Peacocke and John Polkinghorne), it gained further traction through its adoption and modification by Alister E. McGrath, who added the heritage of Roy Bhaskar to the mix (Bhaskar 1979; McGrath 2006; cf. Losch 2009). Its contemporary popularity is partly because of its wide range of uses, like in Bruce McCormack's interpretation of Karl Barth's theology (McCormack 1995) and N.T. Wright's application to New Testament studies (cf. Losch 2016).

The concept has also been criticised, especially in its application on theology and religion (McMullin 1985). This critique provided, Andreas Losch has – originally based on John Polkinghorne's account of the concept – argued early on for its modification into a more differentiated stance he called 'constructive-critical realism' (Losch 2005, 2010, 2018a), giving the humanities due weight within the epistemological concept (see also Buitendag 2011; Russell 2014). We will follow these discussions and (1) begin the argument in this article with focusing on the *criteria of truth* and assessing them in the classical version of critical realism, both regarding its

application on science and (2) on religion. We continue with (3) a discussion of the nature of the science and religion discourse and (4) examine an alternative approach, contextual coherency theory and (5) its relation to realism, before we (6) deal with what the truth criteria would mean for the constructive-critical realism proposed by Losch. Finally, we will (7) go beyond purely epistemological questions and ask if these philosophical considerations do not necessarily embark us on a journey into ethics, too – which leads to (8) an acknowledgement of the importance of environmentalism in the Anthropocene, which can also be justified on the ground of the constructive-critical realism discussed.

What is truth, according to science?

Barbour's critical realism deals with this most classic question in considering several competing theories of truth and granting each of them their individual moment of truth. We will review the different theories here, following Barbour's evaluations for a start.[1]

The most traditional view of truth is the *correspondence* view of truth: that 'a proposition is true if it corresponds to reality' (Barbour 1997:109). When it rains, it is true to say so. In science, *agreement with data* would be the equivalent criterion.[2]

According to Barbour, this classical realist proposition is not wrong, but needs to be qualified, as in today's science, not everything can be directly observed. Access to reality is often indirect; you need tools to measure data and this way, all data are theory-laden.[3] In his portrayal of the structure of science, he therefore envisions sorts of a hermeneutical circle, where not only observational data have their impact on theories, but those theoretical concepts also influence observation and data in turn.[4]

The alternative *coherence* view 'says that a set of propositions is true if it is comprehensive and internally coherent' (Barbour 1997:109), which does fit the theory aspect of science. Also, the scope of the theory plays a role. Unfortunately, 'there may be more than one internally coherent set of theories in a given domain' (Barbour 1997:110) and reality – consider quantum physics – 'maybe more paradoxical and less logical than rationalists assume' (Barbour 1997:110). As it seems, Barbour is slightly critical of the coherence view.

Finally, there is the *pragmatic* approach to truth, which considers theories that work in practice, so it evaluates their

fruitfulness and suggestiveness. Barbour considers Kuhn's famous account of scientific theory as problem-solving endeavour within these parameters. Fertility is indeed important, he says, but 'whether an idea "works" or is "useful" remains vague unless these concepts are further specified by other criteria' (Barbour 1997:110). Again, he takes the approach with a pinch of salt.

Barbour's conclusion on the issue of truth is hence dominated by the traditional realist stance, according to which the meaning of truth is correspondence with reality. His approach is, however, a *critical* realist approach, insofar as the other criteria count to some degree as well. A plenitude of criteria need to be assessed to judge on the truth question: not only agreement with data, but because all data are theory-laden, coherence and scope of theories do play a role, and finally their fertility is important.

This mix of truth criteria with an emphasis on correspondence seems to make sense, at least in science. How does Barbour apply these considerations on religion, then?

Truth in religion and theology

We start again with a consideration of the first and most essential criterium for any sort of *realism*, which is correspondence. It would probably be hard to deny that truth as an idea of correspondence to a Divine reality does play a role in most religions, too; there is a cognitive component to all sorts of beliefs. Nevertheless, Barbour's and his successors' transfer of critical realism from science to religion[5] is a move that has been challenged, for example, by Ernan McMullin (Losch 2010:407–409; McMullin 1985).

Barbour argues that religious 'data' are made up of individual religious experiences and communal story and ritual, which he admits being 'much more theory-laden than in the case of science' (Barbour 1997:113). So, logically, coherence, scope and fertility play an even more important role. 'As it appears, Barbour is able to creatively modify his set of criteria for the sake of religion. Still, the standard of rationality employed is the natural scientific one', says Losch. Hence, he would remain 'doubtful as to whether it was a wise decision not to rethink the criteria in light of social and human sciences at all' (Losch 2010:403).

Therefore, it can also make sense to even reassess the general idea of critical realism and to apply a more differentiated model to the relation of religion and science; this is why Losch developed 'constructive-critical realism', as he states (Losch 2005, 2018a). In this substantial modification of Barbour's critical realism, the divergent disciplines are considered in a way that conforms to their particular method (a Torrencean idea). Following the hermeneutic tradition, the role of the subject in social sciences and particularly in

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1. The sources of Barbour's presentations in these regards are somewhat opaque. *Religion and Science*, which we follow here, is an extended version of Barbour (1990), the text and the footnotes related to our considerations are probably identical in the two editions. The first chapter note (in both versions) tells us that 'several sections of this chapter are revisions or summaries of portions of two earlier books', referring to Barbour (1966) and Barbour (1974), where 'the original passages are identified in the notes', Barbour (1997:340). In the books mentioned, Barbour, however, does not provide a similar overview of theories as in the more recent book we use here. In his early *Issues in Science and Religion* he orients himself with Nagel (1961), Margenau (1950) and Northrop (1947), amongst others.

2. The classical source for correspondence theory is certainly Tarski (1956). As being said, Barbour does not reveal the exact souce of his presentation.

3. Here Barbour explicitly refers to Quine (1963).

4. Cf. the presentation of Barbour's view of science in Losch (2018b).

5. Robert John Russell (2014) called this the 'bridge' between the disciplines: 'With these arguments in place, Barbour was prepared to make his crucial, methodological claim that, in my term, "bridges" science and religion: *the basic structure of religion is similar to that of science in some respects, though it differs at several crucial points*'.

humanities is not only more instructive to research than in the natural sciences, but also the object of study is itself symbolically structured and culturally coded. For Barbour's original approach, this would eventually be integrated in the increased 'theory-ladeness' of data, but it makes sense to point out that *the 'data' itself is of another quality* here.[6]

As theology certainly belongs to an area close to humanities (if to any *Wissenschaft*), there are therefore *double* hermeneutics in place. While the role of the subject is to be regarded *critically* in natural sciences, in humanities, it plays a much more *constructive* and constituting role; here, the personal element even 'structures the social reality under "observation"' (Losch 2005:282–283). Following this, we do not employ only one standard theory of science on everything in science and religion, as Barbour does, but allow for an internal differentiation of theory according to disciplines considered. Of course, we still have an overarching framework – which may be necessary to bridge science and religion – but at least it is a more differentiated one. In some sense, Losch's idea of a constructive-critical realism is really *uni-versal* because it both considers *the one* reality we live in *and the many* aspects of it we experience.

If we go on with this, what does this now mean regarding theories of truth and their criteria? How does constructive-critical realism influence them, especially their application on the domain of religion?

Before we come to these questions, let us reflect a moment on the nature of the science and religion discourse.

About the science and religion discourse

I am convinced we are somewhat misguided by Barbour's approach, as (being a *scientist*-theologian) in my view, he did not take into account properly that the science and religion discourse is not a discourse with two equals. In truth, it is a *theological or sometimes maybe philosophical discourse* about the influence of science on religion, not a scientific one at all. Therefore, even when sticking to some sort of critical realism in the form of a constructive-critical realism as an overarching theory and universal epistemology, the science and religion discourse itself clearly belongs into the domain of the *humanities*, where we said the constructive role of subjectivity is dominant. In terms of the criteria Barbour listed, *coherence, scope* and also *fruitfulness* therefore play a highly important role.

I hence would also employ a somewhat critical stance towards Niels Henrik Gregersen's take that the science and religion discourse's nature would be *transdisciplinary* (Gregersen 1998:186). I, however, agree with Gregersen's position that the relation of science and theology within this dialogue is *asymmetrical*, which is simply because of the necessary naturalism intrinsic to the scientific method

6. Further development to differentiate between the approaches of the social sciences and of the humanities is needed in Losch's approach, admittedly.

(see also Losch 2018b). An inspiration of science through theological thought is rare (although possible, cf. Losch 2022).

Contextual coherence

Although the whole Barbourian idea to approach the issue of truth from the angle of a philosophy of (natural) science may be difficult, we must assess the possible criteria he mentioned. The two criteria of coherence and fruitfulness we highlighted are considered in Niels Henrik Gregersen's *contextual coherence theory*. From the perspective of the science and theology discourse actually taking place, such a contextual coherence theory could make more sense, as the discourse is situated within the *theological* field. Let us therefore have a look at what the contextual coherence theory claims.

Like the theories of science Barbour mentions, contextual coherence theory was originally developed for taking a fair account of ongoing *scientific* activities. Gregersen builds on philosopher Nicholas Rescher (Gregersen 1998:190; Rescher 1973, 1992), who like Barbour denies a sharp distinction between theory and data, 'since all our experiential data are mediated through our cognitive systems' (Gregersen 1998:191). Rescher also differs from a foundationalist approach like the well-known covering law model (also called Hempel–Oppenheimer model) is one.[7] Data nevertheless plays an important role, i.e., in the form of experience: 'coherence does not only mean *inner logical consistency* between propositions', it indicates 'a *systemic ordering of contextual propositions* that have grown out of experience' (Gregersen 1998:193).

The self-consistency that Rescher aims for hence is only one aspect of his approach. There is also a pragmatic emphasis on experience or data, resulting in the 'stunning' title of his efforts: 'Pragmatic Idealism' (Gregersen 1998:190). Both aspects are co-developing in Rescher's analysis, establishing a twofold cycle. First, there is the *theoretical cycle*, 'which controls the intellectual consistency of the conceptual schemes'. Then, we also have an *applicative cycle* 'in which the evidences for pragmatic utility and fertility with respect to further research has to be shown' (Gregersen 1998:193). Both cycles support each other, resulting in an 'inbuilt evolutionary dimension … The trials and errors of nature have their parallels in the domain of epistemology' (Gregersen 1998:194). Knowledge advances similar to how nature progresses.

In some sense, Rescher's cyclical approach as portrayed by Gregersen appears similar to Barbour's hermeneutical circle. Although it is meant to be a theory about science, coherence theory's strong emphasis on coherence in the interpretation of data may nevertheless be born out of the *philosophical* context in which contextual coherence theory itself was born, which is more closely aligned with *humanities* than science. This seems to be the area where it fits most. As the science and religion discourse belongs into this field too, I think we

7. For a list of main differences see Gregersen (1998:192–193).

can embrace contextual coherence theory as an appropriate description for the discourse itself.

And what about realism?

Accepting this leads us to the question what to make out of Losch's approach of constructive critical realism, particularly regarding its approximation to a correspondence view expressed by the fact that its qualified noun is still some sort of 'realism'. After first embracing it, it might appear outdated, but on a second look, it could make sense to keep it. Even within his adoption of contextual coherence theory, Gregersen does support that 'truth involves some sort of correspondence' (Gregersen 1998:199). This is one aspect of any metaphysical realism.[8] Likewise, the originator of the coherence theory, Nicholas Rescher, supports metaphysical realism (Rescher 1992:275) too. We have seen how correspondence to experienced data does play a role in his approach.

Therefore, some sort of a qualified realism in Barbour's terms still makes sense. More promising than Barbour's 'one size fits all' approach, however, might be developing a theory of truth that is corresponding to a specific disciplinary domain. The question how to connect these competing theories of truth into sorts of a metatheory to acknowledge the unity of our world is where the idea of constructive-critical realism seems to make sense.

In our context this would mean – while acknowledging the respective moment of truth of all the approaches to the subject matter – to emphasise the correspondence aspect in *science* and a coherence view in *theology and religion*. While Barbour's critical realism is eventually a good approximation for what is going on in *science*, Gregersen's contextual coherence theory might be more applicable in *humanities*. Now, both claim their theories to be equally valid for both domains, and maybe that is problematic. While Barbour has a science view of things, Gregersen's approach is dominated by a more hermeneutic angle in his theory choice.

A philosophy of *science and religion* would, however, because of the nature of that discourse, be mainly situated in the theological domain and hence favour a coherence theory, as laid out by Gregersen, for instance. Therefore, the *criteria of truth* in constructive critical realism need to be coherence, scope and fertility for the humanities, while sticking to the emphasis on correspondence in science. Now, that is similar to what Barbour said, but we know better now why it has to be the case.

Interim summary

We have considered truth criteria regarding their role in constructive-critical realism. The basic idea of the stance to differentiate between the divergent domains of science and humanities makes sense, especially when situating theology and religion in the latter, more hermeneutically oriented,

field. The quality of the data is different here, as the data itself is symbolically structured, culturally coded and 'double hermeneutics' are in place (Losch 2005).

While Barbour's emphasis on correspondence in *science* still seems to be justified, his highlight on the other criteria (coherence, scope and fruitfulness) in *religion* makes sense. So in these regards, Barbour also lives up to the challenges a constructive-critical realism demands, and we don't need to modify this approach regarding truth criteria. We can, however, also use contextual coherence theory to describe this aspect. We just should be aware that the science and religion discourse itself belongs *within theology*; hence, the constructive dimension of the role of the subject is strong here, and that is why coherence, scope and fertility are indeed the *most important* truth criteria. This is laid out in an exemplary way by contextual coherence theory, which seems therefore appropriate to adopt in humanities and hence in the science and religion discourse as well. Losch's constructive-critical realism in fact also allows and demands such a shift of emphasis in this academic domain. While sticking close to a critical realism in science, it remains the most universal approach to knowledge available at time. In an age marked by 'two cultures' (Snow 1959), this quest for unity of our 'one world' (Polkinghorne 1987) remains essential.

Beyond epistemology

Both critical realism and contextual coherence theory have been developed at the example of *science*, although in the first case by a scientist-turned-theologian (Barbour), and in coherence theory's case by somebody trained within the mathematical and philosophical community (Rescher). Now, we stated that the main difference between science and the field of humanities is the 'personal' character of the object of research, its symbolic structure. We compared that aspect in this article to another *quality* of data. This different quality, however, leads to another decisive difference, which we called 'double hermeneutics', a stronger *reciprocity* between the knower and the known. While one has to consider critically the influence of the knower (and their gender, too, cf. Russell 2014) already in science, in social sciences (cf. their concept of 'bias') and humanities it becomes crucial to the research itself.

Even more, we also witness a *new kind of fruitfulness* emerging as an eventual additional truth criterium. When the important role of the knower in research is acknowledged, any kind of research automatically receives an ethical dimension because it somewhat becomes a personal decision, too. Such an epistemology includes ethics. The ideal of objectivity is then only one value at stake here, though still an important one.

Michael Polanyi already differentiated between the concepts of *verification* for scientific endeavours and *validation* for the field of religion,[9] as Losch put it (2005):

8.To be exact, it is the third aspect of metaphysical realism Hilary Putnam mentions in an outline of his internal realism (Putnam 1990:30; Gregersen 1998:198–199).

9.He also included mathematics here (Polanyi 2003:202).

[*B*]oth are an acknowledgement of a commitment: they claim the presence of something real and external to the speaker. The structure of commitment remains unchanged, but its depth becomes greater; when we pass from verification to validation, we rely increasingly on internal rather than external evidence. (p. 280)

In Polanyi's terms, the new kind of fruitfulness criterium in religion we just introduced is sort of a *personal validation*, then. This underlines the importance of the conclusions regarding the acknowledgement of a personal and ethical dimension in any epistemology, which Losch's constructive critical realism rightfully advocates:

'Constructive-critical realism recalls the ethical standards for adequately constructing cultural systems' (Losch 2005:285).

Outlook: into the Anthropocene

Our conclusions lead us further into ethical thinking. It has been observed that realism-oriented approaches are more prone to support *environmentalism*, as this epistemological stance recognises more strongly our embeddedness in nature than nominalist (or constructivist) positions do (Hübner 1995:95). Constructive-critical realism, adopting and modifying Hefner's idea of human beings as created co-creators (Hefner 1993; Losch 2005:283–285) seems to preserve this orientation – crucial in times of climate change – while acknowledging the important role of cultural construction and ethical decisions in the process of knowing. In some sense, this is also the cognitive move made when calling the current geological age the 'Anthropocene': as we are obviously part of nature, our decisions and actions have an impact on reality, which is not only under observation but subject to change. Nature is itself increasingly culturally coded, so to say. 'Human activities are exerting increasing impacts on the environment on all scales, in many ways outcompeting natural processes' (Crutzen 2006).

The new kind of fruitfulness advocated here then should not mean pragmatic productivity only. As Losch (2005) stated, it presents:

[*A*]n ethical task to distinguish the quality of the fruits, and to judge the goodness of our fruits we need a purpose that counts. According to constructive-critical realism, this is humankind's purpose to shape nature in cooperation with God and with the means of culture toward increasing realization of freedom in relationship. (p. 285)

He later modified his statement insofar that it is now 'humankind's purpose to shape nature *in creative and responsible participation in God's creation* and with the means of culture towards increasing realization of freedom in relationship' (Losch 2019:263, italics mine). 'Participation in God's creation' is an expression that makes much sense in the era of the Anthropocene. The aim of 'freedom in relationship' can be underwritten, but these days it is our relationship to Earth and rootedness in this common ground, which is most endangered. Planet Earth is the basis of our freedom in this cosmos. Supporting constructive-critical realism could

therefore be a welcome acknowledgement of our increasing entanglement with nature and responsibility for our thoughts and deeds in the Anthropocene.

Conclusion

In this paper, the science and religion debate, inspired by critical realism, is identified as mainly *theological* discourse about the influence of science on religion. Within that discourse, the analysis of truth criteria in Losch's constructive-critical version of realism proposes an emphasis on *correspondence* in science and *coherence* in the social sciences and the humanities (including theology), while the differences between these academic disciplines need to be discussed further. Regarding truth criteria of constructive-critical realism, the deeper meaning of the criterium of *fertility* in this philosophical stance was also highlighted, *including ethical fruitfulness*.

Acknowledgements

References

Barbour, I.G., 1966, *Issues in science and religion*, Prentice-Hall, Englewood Cliffs, NJ.

Barbour, I.G., 1974, *Myths, models and paradigms: The nature of scientific and religious language*, SCM Press, London.

Barbour, I.G., 1990, *Religion in an age of science*, 1st edn., Harper & Row, San Francisco, CA.

Barbour, I.G., 1997, *Religion and science: Historical and contemporary issues*, 1st edn., Harper, San Francisco, CA.

Bhaskar, R., 1979, *The possibility of naturalism: A philosophical critique of the contemporary human sciences*, 1st edn., Humanities Press, Atlantic Highlands, NJ.

Buitendag, J., 2011, '"Epistemology models ontology" – In gesprek met John Polkinghorne', *HTS Teologiese Studies/Theological Studies* 67(1), a897. https://doi.org/10.4102/hts.v67i1.897

Crutzen, P.J., 2006, 'The "Anthropocene"', in E. Ehlers & T. Krafft (eds.), *Earth system science in the anthropocene*, pp. 13–18, Springer-Verlag, Berlin/Heidelberg.

Gregersen, N.H., 1998, 'A contextual coherence theory for the science-theology dialogue', in N.H. Gregersen (ed.), *Rethinking theology and science: Six models for the current dialogue*, pp. 181–231, Eerdmans, Grand Rapids, MI.

Hefner, P., 1993, *The human factor: Evolution, culture, and religion*, Fortress Press, Minneapolis, MN.

Hübner, J., 1995, 'Die Wirklichkeit der Natur im Streit zwischen Religion und Wissenschaft', in W. Gräb (ed.), *Urknall oder Schöpfung?: Zum Dialog von Naturwissenschaft und Theologie*, pp. 89–100, Kaiser Gütersloher Verl.-Haus, Gütersloh.

Losch, A., 2005, 'Our world is more than physics: A constructive – Critical comment on the current science and theology debate', *Theology and Science* 3(3), 275–290. https://doi.org/10.1080/14746700500317271

Losch, A., 2009, 'On the origins of critical realism', *Theology and Science* 7(1), 85–106. https://doi.org/10.1080/14746700802617105

Losch, A., 2010, 'Critical realism – A sustainable bridge between science and religion?', *Theology and Science* 8(4), 393–416. https://doi.org/10.1080/14746700.2010.517638

Losch, A., 2016, 'Wright's version of critical realism', in C. Heilig, J.T. Hewitt & M.F. Bird (eds.), *God and the faithfulness of Paul: A critical examination of the Pauline theology of N.T. Wright*, pp. 101–114, Mohr Siebeck, Tübingen.

Losch, A., 2018a, 'Appreciating faith and culture in an age of scientific reasoning: On constructive-critical realism', *Theology Today* 75(2), 154–166. https://doi.org/10.1177/0040573618783419

Losch, A., 2018b, 'Modelling the relation between religion and science', in Z.L. Imfeld & A. Losch (eds.), *Our common cosmos: Exploring the future of theology, human culture and space sciences*, pp. 36–50, Bloomsbury Publishing PLC, London.

Losch, A., 2019, 'The need of an ethics of planetary sustainability', *International Journal of Astrobiology* 18(3), 259–266. https://doi.org/10.1017/S1473550417000490

Losch, A., 2022, *Der gestirnte Himmel über uns: Theologie, Naturwissenschaft und Ethik*, Theologischer Verlag Zürich, Zürich.

Margenau, H., 1950, *The nature of physical reality: A philosophy of modern physics*, McGraw-Hill, New York, NY.

McCormack, B.L., 1995, *Karl Barth's critically realistic dialectical theology: Its genesis and development 1909–1936*, Clarendon Press, Oxford.

McGrath, A.E., 2006, *A scientific theology: Reality*, T & T Clark, London.

McMullin, E., 1985, 'Realism in theology and science: A response to peacocke', *Religion and Intellectual Life* 2(4), 39–47.

Nagel, E., 1961, *The structure of science: Problems in the logic of scientific explanation*, Harcourt Brace & World, New York, NY.

Northrop, F.S.C., 1947, *The logic of the sciences and the humanities*, Macmillan, New York, NY.

Polanyi, M., 2003, *Personal knowledge: Towards a post-critical philosophy*, Routledge, London.

Polkinghorne, J., 1987, *One world: The interaction of science and theologie*, 1st edn., Princeton University Press, Princeton, NJ.

Putnam, H., 1990, *Realism with a human face*, Harvard University Press, Cambridge, MA.

Quine, W.V., 1963, 'Two dogmas of empiricsm', *From a logical point of view: 9 logico-philosophical essays*, 2nd edn., pp. 20–46, Harper & Row, New York, NY.

Rescher, N., 1973, *The coherence theory of truth*, Clarendon Pr, Oxford.

Rescher, N., 1992, *A system of pragmatic idealism, volume 1: Human knowledge in idealistic perspective*, Princeton University Press, Princeton, NJ.

Russell, R.J., 2014, *Ian Barbour's methodology in science and religion*, viewed 12 May 2022, from https://www.theologie-naturwissenschaften.de/en/dialogue-between-theology-and-science/editorials/barboursmethodology.

Snow, C.P., 1959, *The two cultures and the scientific revolution*, University Press, Cambridge.

Tarski, A., 1956, 'The concept of truth in formalized languages', in J.H. Woodger (ed.), *Logic, semantics, metamathematics: Papers from 1923 to 1938*, pp. 152–278, Clarendon Press, Oxford.

Van Kooten Niekerk, K., 1998, 'A critical realist perspective on the dialogue between theology and science', in N.H. Gregersen (ed.), *Rethinking theology and science: Six models for the current dialogue*, pp. 51–86, Eerdmans, Grand Rapids, MI.